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PRODUCTION OF SAUER RÜBEN[1]

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INTRODUCTION

Sauer rüben, a product made by the fermentation of turnips, offers an economical means of utilizing a portion of a farm crop which is widely grown in the United States. In addition to the regular crop, which supplies the large city markets, a fall crop of turnips is grown on many farms. A portion of this crop can be put up for winter use as sauer rüben. Sauer rüben is not only a means of preserving a staple crop for winter use, but it also adds variety to the daily fare. During the fermentation much of the turnip odor and flavor is lost, and consequently many people who do not relish the turnip flavor have pronounced sauer rüben an appetizing food.

EXPERIMENTAL PROCEDURE

SELECTION OF THE RAW MATERIAL

In testing the adaptability of turnips for sauer rüben, turnips were grown on the Arlington Experiment Farm of the Department of Agriculture at Rosslyn, Va., both in the spring and in the fall. It was found that a good yield of satisfactory turnips could be produced either in the spring or in the fall, provided the seasons were not so hot and dry as to produce a woody strong-flavored turnip. The fall crop consistently gave better sauer rüben, as hot weather usually set in before the spring crop was mature. It was found that to produce a sauer rüben of excellent flavor and texture, turnips must be used that have enough sugar to support a good fermentation, enough moisture to cover the product when packed into jars for fermentation, and a texture neither woody nor tough. Sugar determinations on 17 samples of turnips showed that the sugar content ranged from 3.25 to 5.31 percent (calculated as dextrose), the average being 4.17 percent.

[1] Sauer rüben is the German name for a product prepared from turnips by fermentation similar to that used in making cabbage sauerkraut.

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The turnips were used as soon as possible after they were pulled in order to preserve the natural crispness and juiciness, since both are necessary to produce a uniform, easily cut shred.

The sugar content and flavor of turnips vary with maturity. In order to determine the effect of maturity on the finished product,

FIGURE 1.—Turnips graded according to size: *A*, small; *B*, medium; *C*, large.

sauer rüben was made from turnips of three sizes: Small (less than 2½ inches in diameter); medium (between 2½ and 3½ inches); and large (3½ to 5 inches) (fig. 1).

The average results from 45 samples of sauer rüben are shown in table 1.

TABLE 1.—*Effect of size of turnip on acidity and quality of sauer rüben*

Size	Average acidity as lactic acid	Texture and flavor
	Percent	
Small	1.40	Tender but lacking in flavor.
Medium	1.54	Tender and full flavored.
Large	1.58	Inclined to be woody and tough.

Although the average acidity was slightly higher in the large than in the medium-sized turnips, the flavor and texture were less desirable. The large turnips were inclined to be pithy and woody, whereas the small ones were lower in sugar content and lacked the full flavor possessed by the medium-sized turnips.

Seventeen varieties of turnips and six other kinds of root vegetables were converted into sauer rüben. Eighteen were packed at the same time in closed glass containers; the remaining five were packed at other times. Since these varieties were grown at the same time and under the same conditions, it would seem that a fair comparison could be made as to their usefulness for sauer rüben. The product was graded on the merits of its color, odor, texture, flavor, and acidity. From these factors, general ratings of excellent, good, fair, and poor were given. It is quite possible, however, that the same varieties, grown in different parts of the country and under different soil, temperature, and moisture conditions, would rate in different orders.

Table 2 shows that only sauer rüben made from the Purple Top Strap Leaf received a grade of excellent. In good growing seasons this turnip produced a very juicy, sweet, white root, which fermented into an excellent product. The purple at the top of the root faded during the fermentation until it could scarcely be distinguished from the rest of the product. The products given a rating of poor were mostly from woody turnips of a very strong, hot flavor.

TABLE 2.—*Acidity and grade of sauer rüben made from various root vegetables*

Vegetable	Acidity	Grade
Turnips:	*Percent*	
Purple Top Strap Leaf	1.65	Excellent.
Tokyo	1.66	Good.
Extra Early Purple Top Milan	1.44	Do.
Purple Top White Globe	1.62	Do.
Yellow Globe	1.58	Do.
Extra Early White Milan	1.32	Do.
Japanese Shogoin	1.66	Do.
Early Snow Ball	1.30	Fair.
Large White Norfolk	1.36	Do.
Early White Flat Dutch	1.89	Do.
Long Cowhorn	1.63	Do.
White Egg	1.79	Do.
Golden Ball	1.56	Do.
Large Amber Globe	1.46	Poor.
Early Red Top Strap Leaf	1.57	Do.
Seven Top	.93	Do.
Round White Vertus	(1)	Do.
Other root vegetables:		
White Sweet Swede rutabaga	1.94	Fair.
Ashton Market rutabaga	1.40	Poor.
Winter radish	1.46	Do.
Giant White Belgian carrot	(1)	Do.
Golden Tankard mangel	(1)	Do.
Giant Yellow Intermediate mangel	(1)	Do.

[1] Not determined.

Wong Bok or Chinese cabbage was also shredded, salted, and fermented, but the product had a bad odor, was slippery, and on the whole was not desirable. The acidity produced was 1.46 percent.

PREPARATION OF THE RAW MATERIAL

The turnips, from which the tops, blemishes, and all other inedible portions were removed, were rinsed in cold water until clean, and if slightly wilted, were soaked for sometime to restore the crispness.

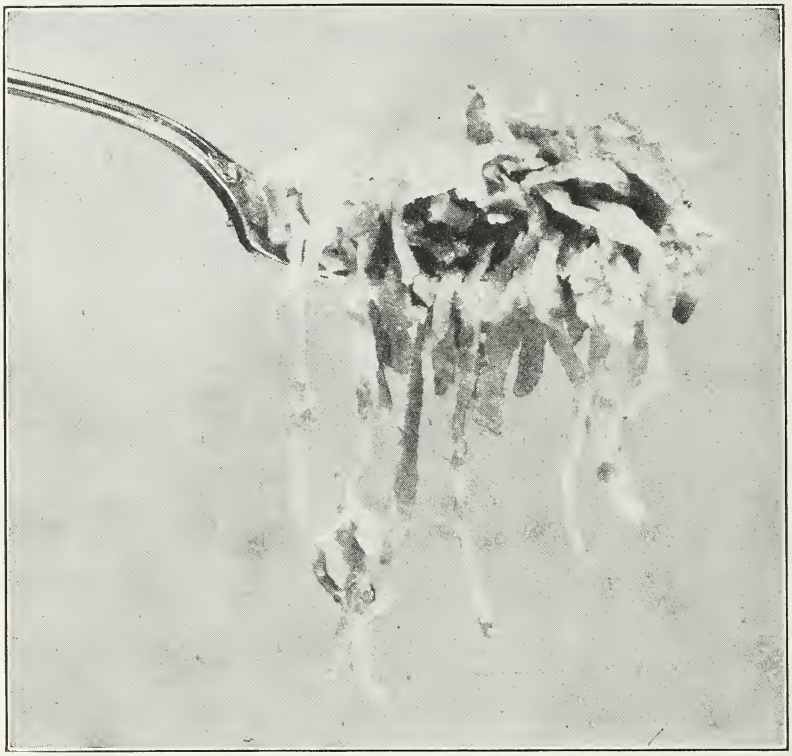

FIGURE 2.—Shredded sauer rüben.

Washing is not advisable, since it would remove nearly all the bacteria necessary for proper fermentation.

Since the peel contains a great deal of the turnip flavor, experiments were undertaken to ferment peeled as well as whole turnips. It was concluded from the results obtained on 17 samples that while peeling removed considerable of the turnip flavor, it also removed considerable sugar, resulting in a lower yield of acid. The average acidity of the fermented whole product was 1.46 percent, whereas the peeled product showed 1.19 percent. Spoilage occurred much more quickly in the peeled product.

Three methods of cutting were tested in preparing the turnips for fermentation. The raw turnips were (1) sliced, (2) ground with a food chopper, and (3) shredded into long thin shreds.

It was found that the turnip slices had a tendency to pack together and did not yield an attractive product. Good fermentation was obtained with the ground material, but although a pleasing flavor and acidity were present, the product lacked the characteristic sauerkraut texture and consistency. The shredded product more closely approached the appearance and texture of sauerkraut than either of the others, and fermented well, producing an excellent flavor and high acidity.

The shredder used was a motor-driven disk type with $\frac{3}{16}$-inch holes in its surface. Similar shredders can now be obtained for most motor-driven food mixers. There are also a number of hand-operated sliding shredders and slicers on the market, any of which could be used. The shreds produced were about three-sixteenths of an inch in diameter, almost cylindrical in shape, and ranged in length from 1 to 6 inches. When the shreds were packed sufficiently loose to permit good fermentation, this method yielded a product having the general appearance and texture of sauerkraut (fig. 2).

Table 3 shows the acidities obtained when the raw turnips were cut by different methods.

TABLE 3.—*Acidity of sauer rüben made from turnips cut in different ways*

Method of cutting	Average acidity	
	Unpeeled	Peeled
	Percent	*Percent*
Sliced	1.30	1.17
Ground	1.40	1.23
Shredded	1.50	1.16

The unpeeled shredded product produced the highest average acidity, and at the same time resembled sauerkraut more closely than did the sliced or the ground samples. The peeled, ground turnips produced a slightly higher acidity than the peeled turnips that were sliced or shredded.

All the subsequent experiments were carried out with shredded material.

THE FERMENTATION

TEMPERATURE

The fermentation of the sauer rüben was carried out in a room the temperature of which usually ranged from 70 to 75° F., with extreme variations to 68 and 80°. Since wide fluctuations in temperature cause contraction and expansion of the juice, the temperature was maintained as nearly uniform as possible in order that the product would not be alternately exposed to the air and then covered with juice, a condition which encourages the growth of molds on the moistened walls of the jars. Conditions required by the bacteria involved in the fermentation were maintained as closely as possible.

SALT

To insure uniform salting and flavor throughout the mass, the shredded turnips were put in enameled pans and thoroughly mixed with salt before they were placed in the fermentation jars. It was found that 2.5 percent of salt, the proportion ordinarily used for sauerkraut, made the sauer rüben too salty, and that a more tasty product was obtained by using 2.15 to 2.25 percent salt, which is about 3.5 ounces of salt to 10 pounds of shredded turnip.

METHODS OF PACKING

Three methods of packing were tested:

Method 1.—The turnip shreds were packed into open stone jars fitted with wooden covers, weighted, and allowed to ferment until the maximum acidity had been reached. The product was then packed into tin cans, filled with a 2-percent brine solution, and heated in flowing steam. It was found that if the cans were steamed for 2½ minutes, then sealed and resteamed for 7 minutes, a very good product was obtained. This method produced a tender tasty food, which would keep almost indefinitely.

Method 2.—The shredded turnips were fermented in open stone jars until the evolution of gas had ceased; then the surface was covered with a layer of white mineral oil. Unless the oil was used, a slimy growth soon covered the surface, and the sauer rüben quickly became dark and soft. By this method it was possible to keep the sauer rüben at room temperature in open jars for 6 months, after which time spoilage occurred because of the evaporation of the juice to a point where the shreds were exposed to the air. The product obtained by this method had a more finished flavor than that obtained by method 1, probably because of the longer period of aging. After being packed and processed in tin containers, the sauer rüben made according to method 2 was slightly softer than that made by method 1.

Method 3.—The shredded turnips were packed in 2-quart glass jars, which held approximately 4 pounds of turnips each when packed firmly. Because of the pressure produced by the gas released during the initial fermentation, the lids of the jars had to be left loose. By this means the gas was allowed to escape, yet at the same time a sufficient concentration of carbon dioxide to prevent aerobic spoilage was maintained over the fermenting material. As the evolution of the gas lifted considerable quantities of the juice to the top of the jar, causing it to overflow, the jars were placed in enameled pans until the period of gas formation was over. Once each 24 hours the lids were removed, the shreds were pushed down into the jars by means of a wooden spoon or blunt wooden stick, the lost juice was returned to the jars, and the lids were replaced. As soon as the gas ceased to be given off, which required about 4 days, the jars were sealed tight and stored at room temperature. The fermentation was generally completed in 12 to 14 days, and the product was then ready for use. The product put up in this manner has been kept for 3 years, and is still in excellent condition, although heat has not been applied.

One great advantage of this method is that the sauer rüben can be put up in containers of proper size for home consumption, obviating the necessity of rehandling.

A comparison of 10 samples of sauer rüben packed in open and closed jars showed an average acidity of 1.61 percent for the closed jars and 1.32 percent for the open jars. The difference may have been owing to the aerobic bacteria which grew in the open jars during the latter part of the fermentation and decomposed the lactic acid. This growth eventually spoiled the product, since it was not protected from the air.

EFFECT OF AIR AND TEMPERATURE ON SPOILAGE

Sauer rüben has a tendency to darken upon exposure to air. When sauer rüben which had just started to ferment was exposed to the air,

FIGURE 3.—Canned sauer rüben: *A* was not exposed to air; *B* was exposed to air for 4 hours.

it began to turn dark within a few hours. However, the further the aging process had progressed, the longer this darkening was delayed. Cooked sauer rüben kept for some time without showing this effect. The effect of air on sauer rüben is demonstrated in figure 3. The lid was removed from jar *B*, and the material was exposed to the air for about 4 hours. The darkened area is greater at the top of the jar and becomes progressively less with depth. Further evidence of this oxidation effect is shown in figure 4.

It was necessary at all times to keep the surface of the sauer rüben covered with liquid to prevent the growth of undesirable aerobic bacteria, and if a scum formed it was skimmed off. Also, the lower the temperature at which the sauer rüben was kept, the less spoilage occurred.

THE FINISHED PRODUCT

STORAGE

Most of the samples of sauer rüben were stored at room temperature to test the keeping quality under ordinary conditions. A few samples were stored at 42° F. The sauer rüben kept very well at room temperature as long as it was protected from the air. It kept under oil until evaporation caused the shreds to be exposed. That portion put up in sealed glass jars, but not heated, has kept for 3 years and shows no signs of spoilage.

CANNING

Sauer rüben put up by each of the three methods was removed from the jars and canned in tin containers. After the cans were

FIGURE 4.—Darkening effect of air on sauer rüben: *A* was not exposed to air; *B* was exposed to air.

packed firmly with the sauer rüben and the juice was apportioned among them, they were filled with 2-percent brine, and placed in flowing steam for 2½ minutes to remove all air which had been incorporated during packing. The cans were then sealed, resteamed for 7 minutes, and cooled in water. It was found that longer steaming produced a soft product, whereas steaming for a shorter period failed to preserve it. Unlacquered cans in which sauer rüben was packed showed some blackening of the tin after 6 to 10 months' storage at room temperature.

SUMMARY

Studies on the production of sauer rüben demonstrated that an appetizing food can be made from a good grade of turnips.

A good product was made from both spring and fall turnips, although better results were usually obtained from the fall crop.

Turnips ranging from 2½ to 3½ inches in diameter produced a sauer rüben of superior flavor and texture, as compared with turnips less than 2½ inches and from 3½ to 5 inches in diameter.

Sauer rüben was made from 17 varieties of turnips and 6 other kinds of root vegetables. The Purple Top Strap Leaf turnip produced a product graded as excellent; six other varieties were graded as good.

Turnips with a total sugar content of 3.25 to 5.31 percent produced good sauer rüben although the higher sugar content was more desirable as it produced a higher acidity.

Peeling the turnips removed some of the sugar and resulted in a product which had a very mild flavor but low acidity and inferior keeping quality.

Shredded turnips produced a sauer rüben of superior quality, which resembled the texture of sauerkraut more closely than did either ground or sliced turnips.

A more tasty sauer rüben was obtained when 2.20 percent of salt was used than with the 2.5 percent of salt ordinarily used in making sauerkraut.

Sauer rüben can be fermented and kept a long time by packing in such a way as to exclude air from the product. Closed glass containers were more effective in this than either open jars covered with mineral oil or jars left exposed to the air.

Sauer rüben can be fermented in closed jars and stored for considerable periods at temperatures ranging from 42° to 80° F. without sterilizing.

Exposure of sauer rüben to the air resulted in a darkening of the product and eventual spoilage.

Sauer rüben can be canned in tins by using a 2½-minute exhaust and a 7-minute cook in flowing steam. This method gives a tender product and insures preservation of the material.

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